

# ATMOSPHERIC AEROSOL CHARACTERIZATION AND CALIBRATION FACILITY

Stephen E. Schwartz & Yin-Nan Lee, BNL

A *facility* for continuous state-of-the-art characterization of atmospheric aerosols and related gaseous precursors over extended periods of time (multiple years).

An ARM-type facility for atmospheric aerosols.

***Precedents:*** Hyytiälä (boreal forest, Finland); EPA urban supersites; Aerodyne; TSI.

***Broader precedent:*** Mauna Loa site for measuring CO<sub>2</sub>.

## ***Objectives:***

1. Long-term and continuous ***local closure experiments*** on:
  - Aerosol optical properties (including RH dependence) and size-dependent composition.
  - Aerosol CCN properties and size-dependent composition.
2. Identify occurrence of ***new particle formation*** events and controlling conditions:
  - Concentrations of putative gas-phase precursors
  - Composition of new particles
3. Serve as ***testbed for new aerosol instruments***.

## ***Facility attributes:***

Maintain a broad suite of such instruments ***running continuously***.

Location should be subject to a ***variety of aerosol types***: aged continental, fairly recent urban, very clean, marine ...

Provide capability for ***calibration*** and for ***laboratory generation*** of aerosols under well specified conditions (or smog chamber studies), allowing characterization by the available suite of instruments.

Requires a ***dedicated staff*** (infrastructure) to operate facility.

Provides ***opportunity for ASP scientists to develop and test algorithms***, e.g., relation of optical properties to size-dependent composition.

## ***Expected Outcomes:***

- Broad repertoire of *simultaneous measurements* of multiple aerosol properties, including diurnal and seasonal cycles.
- Greatly enhanced data available to test *local aerosol closure* algorithms.
- Greatly enhanced data output of instruments which are deployed in ASP field studies but which see little use otherwise.
- Assure *maximum readiness and data quality*, including calibrations, from instruments when deployed on *ASP field projects*.
- *Experience* in accuracy and precision of instruments by running field instrument and facility instrument side by side prior to ASP field projects.
- Host platform for *guest instruments*, especially new methods for characterizing aerosol properties, to be run side-by-side existing instruments, permitting compare and contrast resultant data.

## ***Expected findings:***

- Patterns of ***new particle formation*** and particle growth in relation to presence and concentration of responsible atmospheric constituents.
- ***Composition of new particles*** in relation to responsible gaseous precursors.
- Relations between ***cloud nucleating properties*** of aerosols, size, and composition.
- ***Statistics on skill*** in calculating optical properties and cloud nucleating properties from measured size distribution and composition, guiding modeling.
- Relation of aerosol properties to ***sources and photochemical age***, inferred from gaseous composition: CO, alkyl nitrate, NO<sub>x</sub>/NO<sub>y</sub>, toluene/benzene, etc. and to prior cloud processing.
- Variation of ***specific absorption of BC*** and dependence on aerosol properties.
- ***Markers*** for POA, SOA; anthropogenic, biogenic, anthropogenically enhanced biogenic SOA.

## ***Candidate Measurement Suite***

Aerosol size and number distributions: PCASP and DMA.

Scanning tandem DMA to map out  $f(RH)$ .

Aerosol light scattering: 3-wavelength nephelometer; humidity scanning.

Aerosol light absorption: 3-wavelength PSAP, Aethelometer; humidity scanning.

Photoacoustic absorption

Aerosol chemical composition: AMS and PILS.

Aerosol elemental and organic carbon: EC/OC.

CCN's at multiple supersaturations.

Aerosol total number concentrations: Two CPC's at different cut off sizes.

Gas concentrations:  $\text{SO}_2$ ,  $\text{NH}_3$ ,  $\text{HNO}_3$ ,  $\text{CO}$ ,  $\text{O}_3$ ,  $\text{NO}_x$ ,  $\text{NO}_y$ ,  $\text{H}_2\text{O}_2$

Hydrocarbons by PTR-MS: benzene, toluene, isoprene, and monoterpenes.

***Other instruments as specified by ASP science team.***